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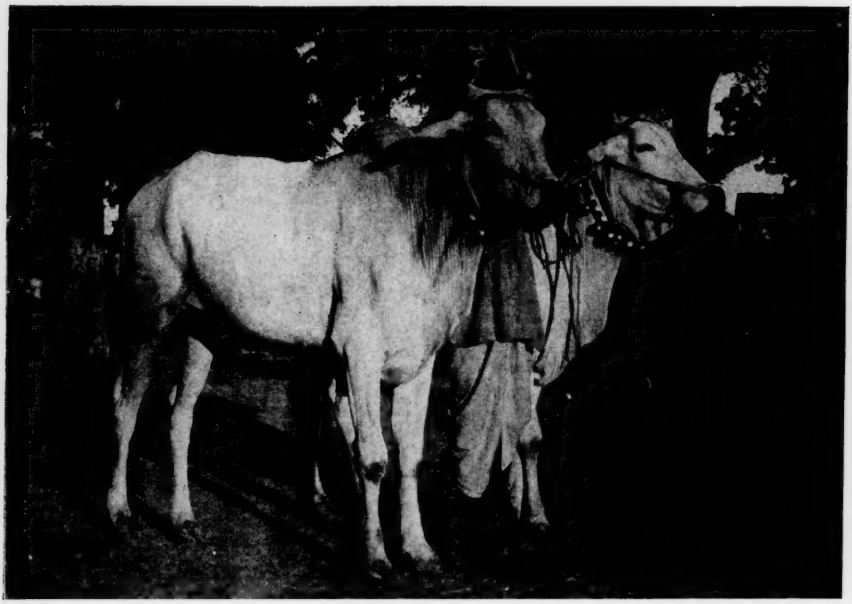

RATH ARISTOCRATS

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The Kallikaks in Retrospect

Noyes Darling—First Maize Breeder

Growth Hormones in Tetraploid Plants

Twin Generals

VOLUME 35 SEPTEMBER, 1944 NUMBER 9

The American Genetic Association

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The

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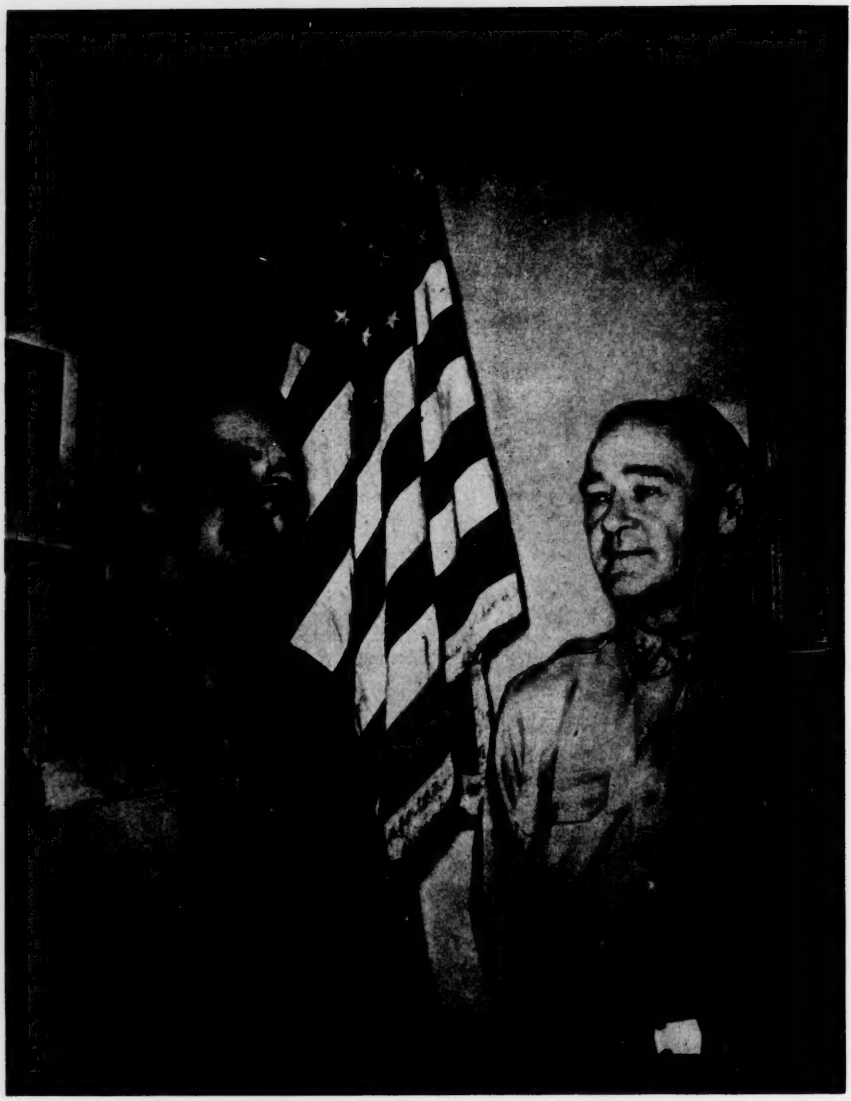

O.W.I. photo

FIVE STAR TWINS

Figure 1

Genetically, identical twins are the same individual in two bodies. The Giles twins, near the top in the Army Air Forces, share between them five stars. Lieutenant General Barney McK. Giles in Chief of Staff of the U. S. Army Air Forces. His brother, Major General Benjamin F. Giles, is in command of the U. S. Army Air Forces in the Middle East. The twins recently met in Cairo. See page 267 for further details.

THE KALLIKAKS AFTER THIRTY YEARS

AMRAM SCHEINFELD

FEW studies in the field of social science have been more widely publicized, and few have had more profound effect on eugenic thought, than that of the "Kallikak" family, with its one branch of defectives and degenerates, and the other of human paragons, as brought to light in 1912 by Dr. Henry H. Goddard.[1]

Geneticists generally (including Professors Thomas Hunt Morgan, J. B. S. Haldane and Lancelot Hogben) long ago turned thumbs down on the methodology and conclusions of the study. But the ghosts of the notorious Kallikaks have not easily been exorcised. Coupled with the equally notorious Jukes family of earlier fame[2] as synonymous with all that is degenerate in the human germplasm, they go marching on through many textbooks and reference works (some published in the last few years), and tens of thousands of college and high school students continue each year to be taught the lessons of these horrible examples.

What motivates the present re-valuation of the study is, first the fact that Dr. Goddard himself virtually demanded it in a rather surprising communication published in *Science* about two years ago.[3] Breaking a long silence, he attacked all those who had criticized his work and accused them of not having read carefully, or having wilfully misinterpreted, what he had reported. Under ordinary conditions, many of those taken to task might have felt that Dr. Goddard's own communication was the best commentary on the weaknesses of his study, and might have been content to let the case rest there. But today the Kallikak study has acquired new implications. For the premise set forth—that there are genetically "superior" and "inferior" categories of human beings, clearly defined as such through unitary traits basing on single gene differences—is one which underlies group concepts which have helped to bring on the present war (as they threaten to bring on other wars), and to which have created many bitter conflicts within our own and other countries. We therefore are less interested in the Kallikak study itself than in the way it has been or may be applied to broader fields of thought; and it thus becomes more than ordinarily important at this time to set the record straight regarding the scientific validity of Dr. Goddard's findings and conclusions.

The "Good" and the "Bad"

For those who have forgotten, or who never delved into the facts of the study, it may be said that it was inspired by the discovery, at the beginning of this century, of two markedly dissimilar family groups residing in the vicinity of the Vineland (New Jersey) Institution for the Feeble-minded. What appeared significant was that, despite a reputed common ancestry, one of these groups had for generations comprised a high percentage of mental defectives and degenerates, whereas the other group had been made up almost entirely of worthy and normal persons. Tracing back the pedigrees for five generations, Dr. Goddard advanced this explanation:

During the Revolutionary War a young soldier, "Martin Kallikak"*, had dallied with a feeble-minded girl who subsequently bore an illegitimate son whom she named "Martin Kallikak, Junior." Growing up as a reputedly feebleminded, drunken and disreputable character, he married and fathered a brood of degenerate and feebleminded children (at least five out of eight), from whom came the "bad" Kallikak branch.

Meanwhile, at the close of the war, the senior Kallikak had married a worthy

*To shield the families involved, Dr. Goddard coined the name "Kallikak" as a compound from the Greek words meaning "good" and "bad."

Quakeress, by her begetting seven fine, worthy offspring, who, in their turn, established the "good" Kallikak branch. Or, in Dr. Goddard's own words:

> The Kallikak family presents a natural experiment in heredity. A young man of good family becomes through two different women the ancestor of two lines of descendants—the one characterized by thoroughly good, respectable, normal citizenship, with almost no exceptions; the other being equally characterized by mental defect in every generation.
>
> . . . We find on the good side of the family prominent people in all walks of life and nearly all of the 496 descendants owners of land or proprietors. On the bad side we find paupers, criminals, prostitutes, drunkards, and examples of all forms of social pest with which modern society is burdened.
>
> *From this we conclude that feeblemindedness is largely responsible for these social sores.* [Italics mine.]
>
> —*The Kallikak Family*, p. 116

While Dr. Goddard has satisfied himself that "The biologist could hardly plan and carry out a more rigid experiment or one from which the conclusions would follow more inevitably," (*ibid.*, p. 69) there is much room for doubt. Indeed, any complicated study of this kind, made in the infancy of genetics and with the rudimentary psychological techniques of thirty years ago, would be expected to have many flaws, and under ordinary circumstances it would be unfair to expose it to the glaring light of present-day analysis. Unfortunately, Dr. Goddard has challenged such inspection by his implication that time has not withered nor new knowledge staled his procedures and findings. What follows, therefore, is offered as an aid in deciding whether the retroactive Kallikak "experiment" did in truth satisfy the criteria for a valid point of departure, proper controls, due attention to environmental factors, correct appraisal of the phenotypes, unbiased evaluation of the data, etc.

For example, a single short sentence, *unaccompanied by any documentation or supporting evidence,* suffices to establish the foundation facts that Martin Kallikak had mated with the girl at the tavern, that he was the father of her child, and that she and her son were feebleminded (*ibid.*, p. 18). Dr. Goddard credits this writer with having contributed "one original idea": that proof of the Kallikak dichotomy, to quote from *You and Heredity,*[4] "rests largely on the assumption that the illegitimate child whom the feebleminded mother chose to call 'Martin Kallikak, Jr.' was indeed the son of the man she designated, which no court would accept as evidence."

Yet, despite Dr. Goddard's contention that "courts have always accepted such evidence and still do," he fails to show that any contemporary court did pass upon the case, and we continue to doubt that modern jurists would accept as valid proof in a hypothetical legal case today the uncorroborated claim of a reputedly feebleminded tavern girl of 150 years ago as to the paternity of her illegitimate child. In any event, it still remains for geneticists to decide whether such evidence would be acceptable as the point of departure for a valid "scientific experiment." If not, then the whole dichotomous aspect of the Kallikak study, balanced precariously like a huge, inverted pyramid with its apex on this single point of the dual mating, topples of its own weight.

Post Mortem IQ's

Equally important questions can be raised regarding the techniques employed by Dr. Goddard or his investigator* to ascertain and classify the mental types and characters of the various Kallikaks, living and dead. Dr. Abraham Myerson, in his analysis of the Kallikak case some twenty years ago,[5] intimated that the diagnoses may have rested largely on "surmises." To this Dr. Goddard only now has replied, "He argues that because he cannot correctly diagnose feeblemindedness, nobody can." Nevertheless, a careful reading of the Kallikak study must arouse suspicion that once the premise of two distinct

*The inference that only a single investigator had engaged in obtaining the data for the Kallikak pedigrees is drawn from the statement by Dr. Goddard in his preface (xi), "The work on this particular family was done by Katherine S. Kite."

kinds of Kallikaks had been established, the investigator had set out with two different intellectual paintpots, to gild the *Lilium candidum* and to tarbrush the *Spathyema foetidus*.

With respect to the then living Kallikaks who were personally interviewed by Dr. Goddard or his aide, present opinions as to how well the IQ's were established will be governed by what psychologists today think of the accuracy of the tests and testing procedures of some thirty-five years ago. But what of the techniques by which the mental grades of long dead and gone Kallikaks were ascertained? Fortunately, Dr. Goddard gives us some clear clues. We quote now from another book of his, *Feeble-Mindedness: Its Cause and Consequences*,[6] (asking the reader to bear in mind that the Martin Kallikak, Jr., herein discussed, is the very first of the "bad" Kallikaks—the illegitimate son of the feebleminded tavern girl—and "Old Moll" is one of his offspring):

> The ease with which it is sometimes possible to get satisfactory evidence on the fifth generation is illustrated in the Kallikak Family. .
>
> The field worker accosts an old farmer—'Do you remember an old man, Martin Kallikak (Jr.) who lived on the mountainedge yonder?' 'Do I. Well, I guess! Nobody's forgot him. Simple, not quite right here (tapping his head) but inoffensive and kind. All the family was that. Old Moll [his daughter] simple as she was, would do anything for a neighbor. She finally died—burned to death in the chimney corner. She had come in drunk and sat down there. . . . That was the worst of them, they would drink. Poverty was their best friend in this respect, or they would have been drunk all the time. Old Martin could never stop as long as he had a drop. Many's the time he's rolled off of Billy Parson's porch. Billy always had a barrel of cider handy. He'd just chuckle to see Old Martin drink and drink until finally he'd lose his balance and over he'd go.'
>
> *Is there any doubt that Martin was feebleminded?*—p. 28.

And a little further on Dr. Goddard adds:

> . . . It is not difficult for one versed in the subject to tell whether or not a man was feeble-minded even though he lived a hundred years ago, providing he made enough impression upon his time for traditions of him to have come down. . . . *Any person living or dead who was so abnormal that neighbors or friends or descendants always spoke of him as 'not quite right' is certain to have been decidedly defective.*
>
> [All of the italics are mine.]

However one might regard this technique of appraising the intelligence of long-dead individuals, the facility with which Dr. Goddard or his investigator could make their diagnoses may explain another remarkable fact, revealed to many of us for the first time through his recent communication: That the entire Kallikak study was not the work of many years, as we had supposed, (for one reason because the account of the investigation begins with the date of 1898), but that it had all been begun and completed between 1910 and the publication date in September, 1912. Contemplating the presumably colossal job of ferreting out the case histories and establishing the mental grades of a thousand or more individuals for five generations back, present-day research workers must either marvel at the speed with which this was accomplished, or else must question the thoroughness with which the study was made.

For geneticists, the Kallikak pedigrees have numerous provocative aspects. What shall be said of Dr. Goddard's assumptions or conclusions that all such conditions in the bad Kallikaks as sexual immorality, alcoholism, pauperism, epilepsy, and criminality, as well as mental defect, were all related manifestations of the same genetic weakness, a unitary condition determined by or resulting from the same recessive gene which produced feeblemindedness? Or of his opinion, in analyzing the fact that the first batch of "bad" Kallikaks had resulted from a mating of the illegitimate Martin, Jr. with a *normal* woman, that this must be considered as "demonstrating that the defect is transmitted through the father, at least in this generation?" If we take his other view that the Kallikak blight was transmitted through simple recessive genes, then the progenitor of the dichotomy, the soldier who later married the Quakeress, must have been heterozygous for these genes. So by

what good fortune was not this bad gene passed along to any of the numerous "good" Kallikaks, or ever manifested itself in defect among any of them? Surely the laws of chance must have awarded some of the seven good Kallikaks the shady half of their father's "demonstrably" mixed heredity.

Other questions will readily occur to those interested in dipping further into Dr. Goddard's books. But remembering always that his study was made in the infancy of genetics, that it was one of the first attempts to apply Mendelian principles to the analysis of human mental or behavior traits, and that Dr. Goddard was primarily a psychologist and not a geneticist, it might be unfair to be too critical of him in this field of science. Where criticism does seem to be justified is in his failure to consider the possibility that differences in environment might have been strong factors in creating at least some of the disparity between the two Kallikak branches. This possibility he dismissed lightly by saying that the bad Kallikaks ". . . . are not open to this argument," and ". . . that we are dealing with a problem of true heredity no one can doubt."

But it so happened that a number of well-qualified authorities did express doubt. We quote Professor Morgan:

> The numerous pedigrees that have been published showing a long history of social misconduct, crime, alcoholism, debauchery and venereal diseases, are all open to the same criticism from a genetic point of view, for it is obvious that these groups of individuals have lived under demoralizing social conditions that might swamp a family of average persons. It is not surprising that, once begun, from whatever cause, the effects may be to a large extent communicated rather than inherited.

The Kallikak Social Philosophy

What should interest us now is why, in view of the easily apparent flaws in the Kallikak study, and its rejection in authoritative circles for many years, it has continued to be given such strong credence and to find such warm support in many quarters? The answer is a simple one. As suggested previously, there are persons everywhere who relish the thought that some groups, races, classes or strains (always including the ones to which they themselves belong) are born to be superior and dominant, and that other groups are destined by nature to be inferior and subordinate. Such a fatalistic concept would permit those on top to smugly keep their place, while relieving them of the necessity of doing very much for those at the bottom, except, perhaps, to suggest that they be prevented from reproducing. Thus, the Kallikak study when it appeared was eagerly welcomed because it apparently offered "scientific proof" that a high proportion of the social and physical ills of mankind were directly or indirectly due to hereditary defects, and that these could be eliminated most effectively, and a super race speedily produced, by breeding out the "unfit." In the sponsorship of this viewpoint, not only did many early eugenists do great damage to the eugenic movement, but they also created widespread suspicion regarding the objectives of the new science of genetics itself, especially as applied to human beings, and thereby undoubtedly hampered its advance. No one in possession of the facts can doubt the existence of pathological genes in human germplasm. It is the unjustified extension of pseudogenetic principles into sociology that is a danger. Very likely there were some wicked genes at work to bring out the worst in some of the "bad Kallikaks." But Goddard's study did not prove this to be so, and social action based on such unsound premises can be very dangerous.

Certainly, Dr. Goddard cannot be held responsible for the misuses of his study, nor should this article be construed as in any sense directed against him personally. As an Emeritus Professor of Psychology, with a long and fruitful career to look back upon, he has earned the respect and esteem of present-day psychologists and psychiatrists for his brilliant pioneering work, and for his many contributions to the study of mental defectives. Considering his treatise

on the Kallikak family purely as a sociological study which uncovered the coexistence of two large family groups, markedly differentiated for generations in their traits, characters and achievements, it was an important contribution; and undoubtedly, it proved the inspiration for much useful research by others. But while due credit might also be given Dr. Goddard for his enterprise in seizing upon the then newly-discovered Mendelian laws, and pursuing the genetic possibilities in the Kallikak family histories, it would ill serve the cause of science to maintain that his findings still stand unshaken after all these years.

A 1944 Interpretation

The fact is that after more than three additional decades of research by innumerable investigators, there is much more uncertainty as to the diagnosis, etiology and genetic aspects of the various types of mental and social deficiency than was evidenced in the sweeping generalizations and pat conclusions of Dr. Goddard's reports. The consensus now would be that a considerable percentage of the cases of feeblemindedness can well be ascribed to hereditary factors, but there is wide disagreement as to what this percentage is, or what genetic mechanisms are involved. Again, with respect to criminality, pauperism, prostitution, degeneracy, alcoholism, etc., while there may be reason to assume that some individuals are more predisposed than others to these conditions because of hereditary weaknesses or inadequacies, the question of environmental influence is so much to the fore that no good evidence regarding the specific parts played by genetic factors has yet been offered; and, certainly, no authorities today, so far as this writer is aware, would join with Dr. Goddard in the conclusion that these assorted conditions all are in the same genetic syndrome, or, as he puts it, that "feeblemindedness is largely responsible for these social sores."

As a final observation, it is well to keep in mind that the Kallikak study was undertaken at a time when geneticists had not yet gone far in showing how environmental influences constantly interoperated with genetic factors to produce, modify or suppress many conditions, or how, as Professor Morgan pointed out, the persistence of a trait through successive generations often might be due to a continuance of the same environment rather than of the same heredity. As applied especially to human behavior, continued research in genetics, supplemented by findings from many other fields of science, has made it increasingly clear that no conclusions can be drawn regarding any human traits of behavior, mentality or physical functioning without making every allowance for the possible influences of environment.

This viewpoint was clearly expressed in the "Geneticists' Manifesto," drawn up at the Seventh International Congress of Genetics at Edinburgh in 1939, on the eve of World War II. Here is the opening paragraph:

> The question "how could the world's population be improved most effectively genetically" raises far broader problems than the purely biological ones, problems which the biologist unavoidably encounters as soon as he tries to get the principles of his own special field put into practice. For the effective genetic improvement of mankind is dependent upon major changes in social conditions, and correlative changes in human attitudes. In the first place there can be no valid basis for estimating and comparing the intrinsic worth of different individuals without economic and social conditions which provide approximately equal opportunities for all members of society instead of stratifying them from birth into classes with widely different privileges.

Thus, we may grant the possibility that a good many of the bad Kallikaks, like their counterparts everywhere, were and are genetically defective, and that the human stock could be improved by suppressing their breeding. But Dr. Goddard's study gives us no acceptable evidence on this score. Perhaps some other investigators, equipped with more modern techniques and approaches, will find it of interest to take up where he left off, to dig further into these pedi-

grees and produce more scientifically valid proof. But until this happens we will have to nurse the suspicion that if all the bad little Kallikaks had been brought up in exactly the same environment as was accorded to all the good little Kallikaks, the distinctions between the two groups might not have been so glaringly marked, and not nearly so many of the bad Kallikaks would have toppled from their places, or fallen by the wayside. Nor, might the Kallikak study itself have fallen down so sorely had it given the bad Kallikaks a fairer break.

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✦

Righting the Differential Birth Rate

There is strong evidence from the data examined that the differential in the birth rate between economic groups of New York City's white population was reduced. It would also seem possible, should the forces at work prior to the war continue, for the birth rate to be approximately related to economic status in the post-war era.

Reduction of the differential for New York City's white population would not be expected to have occurred as an isolated incident. Rather, it would appear more likely that it is part of a trend which can be expected in many of the large cities which have previously experienced sharp decreases in the fertility of their higher income groups.

In speculating on why birth rates have been inversely related to economic status, it is of interest to quote Notestein's opinion. "This [the inverse relationship] does not mean that the poor have many children and the comfortable and well-to-do few children simply because of their respective incomes. The income status affects and is doubtless affected by an entire complex of living standards, attitudes, and customs which are the important factors in determining fertility. A sudden loss of income, even if sustained for several years, is not likely to change established attitudes and standards of one income group to those characteristic of a poorer and more fertile group. Whatever the standard of the group, loss of income means that for that group new babies are a heavier burden than before. The lines of interest set up would therefore lead one to expect a reduction in the fertility of any group in which voluntary control plays a significant part." The fact that the birth ratios of all groups decreased markedly during the depths of the depression would seem to confirm this argument. That it was true for all groups might indicate that a fairly large proportion of the individuals in New York City know how to control fertility and make varying use of this knowledge. Deliberate control of births would also seem to be indicated by the fact that, following improved economic conditions in 1939 and the imminence of conscription in 1940, all groups increased their birth rates.

Probably the most significant finding from the data is the fact that, following the depression years, the birth ratio of the lowest economic group continued to decline and thereafter remained at a lower level.

Contrary to the belief of many persons during the past decade, no evidence has yet been produced to indicate that families supported by public relief increased their fertility after going on relief. It may even be possible that the great depression, which brought many of these families under the influence of public and private social welfare agencies, introduced forces which have resulted in a lowered fertility among these families.

That attitudes and customs have changed among the higher income groups seems evident from the fact that their birth rates have shown the greatest increases since the depression. While they may not continue at their present levels, it is quite possible that the higher income classes will contribute to the future population more nearly in proportion to their economic ability than they have in the past.—Jacobson, Paul H. *Milbank Mem. Fund Quart.* 23:143, 1944.

NOYES DARLING, FIRST MAIZE BREEDER

W. Ralph Singleton

Connecticut Agricultural Experiment Station, New Haven, Connecticut

SYSTEMATIC MAIZE BREEDING BEGAN HERE

Figure 2

About 1750, Thomas Darling, the grandfather of the first maize breeder, Noyes Darling, built this house. Here Noyes Darling was born and on this farm he probably had the maize breeding plots described by him in 1844. Darling's account of the production of a white sweet corn ready for use by July 18 constitutes the earliest controlled experiment in corn breeding of which we have record.

JUST a hundred years ago, there appeared a letter in the *Cultivator,* forerunner of the *Country Gentleman,* describing the development of a sweet corn variety. This letter was signed Noyes Darling, New Haven, Connecticut, November 18, 1844. As far as we are aware this is the first record of the development of a new variety of maize, although we know the American Indians had done a remarkable job of plant breeding, or plant selecting, to bring the maize plant to the high state of productivity found by the first settlers. Doubtless certain of the early colonists had practiced conscious selection in maize since several of the more prominent of the early citizens had made rather careful observations on its pollination. We know that James Logan made the first controlled pollinations in maize, described in a letter written November 20, 1735, just 99 years before the letter of Darling[3]. But the account of Darling is the first record of the development of a new variety of corn, of any type. It was written two years before Robert Reid moved from Ohio to Central Illinois, taking with him the Gordon Hopkins corn that later became one of the parents of Reid's Yellow Dent.

Noyes Darling, like several of the early experimenters with corn, was a lawyer and a leader in the community. He was judge of the county court and

for several terms was a member of one or the other branch of the state legislature from the town of Woodbridge, adjacent to New Haven. His political career culminated in being elected Mayor of New Haven in 1833. He came from a distinguished New Haven family. He is a great-grandson of Joseph Noyes who was pastor of the First Church from 1716-1761. His grandfather, Thomas Darling Sr., built the house here shown about 1750. It has been occupied ever since by a direct descendent. It was undoubtedly the home of Thomas Darling Jr., father of Noyes Darling and in it Noyes Darling was born. It is likely that Darling conducted his experiments on this farm, although it is possible he grew his corn plants on a smaller place on Whalley Avenue in New Haven, his last residence. The fact that he had at least three corn fields located at considerable distance from each other leads us to belief he grew his corn on the Woodbridge farm which is about four miles distant from his later home on Whalley Avenue. The Woodbridge farm consists of about 90 acres, probably about the same as 100 years ago.

The house shown here, if not the site of the first maize breeding plots, was the birthplace of the first maize breeder. It was a well built house and like so many of the early colonial homes seems likely to stand for many years.

The letter here reprinted is a notable example of lucid writing. It would be difficult today to describe a breeding experiment more concisely or accurately. Certain of the principles of Mendel's law were observed i.e. dominance and segregation, but no counts were made of dominant and recessive types. It is the account of a breeding project and not of a genetic experiment and as such is remarkable. The italics in the following letter are Darling's.

From the *Cultivator*, Nov. 18, 1944.

Indian Corn—New Variety

I send you a few ears of a new variety of sweet corn, obtained by the process detailed below:

1st year. I had a very early yellow corn, but quite diminutive in its growth — the stalks not over 3 feet in height, and the ears not over 4 inches in length. Late in the season I planted this in a patch of sweet or shriveled corn, then considerably grown. As soon as the tops or blossoms of the yellow corn protruded, they were cut off, in order that the early corn might be impregnated only by the sweet corn. The result this year was yellow corn of the usual size and appearance.

2nd year. The last year's product was planted by itself, at a distance from all other corn. The result was, a corn growing about five feet in height having ears 7 to 8 inches in length, with a mixture of yellow and white smooth corn and sweet or shriveled corn on the same cob—fit to eat about the middle of July.

3d year. I separated the corn into two parts, the smooth by itself, and the shriveled by itself, and planted them apart, at a distance from other corn. The product this year corresponded mostly with the corn planted, only there was a slight mixture of the shriveled upon the smooth corn, and of the smooth upon the shriveled. The smooth was fit to eat about the middle of July, and the shriveled about a week later.

4th year. I again planted the smooth and the shriveled corn in separate patches. The smooth was fit to eat 18th of July, and the shriveled the 24th. The height of the stalks averaged about five feet. The character of the two kinds seemed now to be permanently established. The smooth corn produced its like, as did the shriveled. The latter has the disadvantage of being yellow, but is earlier than common sweet corn and equally palatable. The smooth corn has a mixture of white and yellow on the same cob.

5th year. I separated the white and yellow smooth corn, and planted them apart from each other. The result is two distinct varieties of smooth corn—the earliest fit for eating 19th of July. The white partakes very much of the tenderness of sweet corn. Some portion of it was about a week later than the rest and grew about a foot higher.

6th year. Having separated the earliest of the white corn from the latest, I planted them apart, and thus procured two distinct varieties of white smooth corn—one fit for

boiling 18th July, the other about a week later. Upon the ears of the earliest variety of last year's growth, I noticed a few scattering kernels of white sweet corn. These were carefully picked out and planted this year by themselves. The result is *a white weet corn fit for boiling 18th of July*, corresponding with the earliest smooth corn in size of stalk and ear.

My object in instituting this experiment having been to obtain a corn, suitable in color and early maturity for marketing, I discarded the yellow varieties, closing the experiment in possession—

1st. Of a white, smooth, eight rowed corn, with ears 7 to 8 inches long, approaching the common sweet corn in flavor, and fit for boiling 18th of July.

2d. Of a similar corn, but somewhat larger in stalk and ear, and a week later.

3d. Of an *eight-rowed sweet corn*, with ears 6 to 7 inches long, and fit for boiling 18th July, (1844, 14th).

The last variety, proving to be the precise article that I was in pursuit of, I have for three years past kept for cultivation that alone. It is that which I send you.

NOYES DARLING.
New-Haven, Ct., November 18, 1844.

Figuring backward from the date of his letter, Darling probably made the first cross in 1836. He used the crossing plot for this, planting the early flint *late in the season* to insure pollination by the somewhat later sweet variety. This is undoubtedly the first crossing plot although the one of Beal in 1881 was the first crossing plot to produce hybrid seed for the sole purpose of increasing yield.[2]

We are much impressed with the last paragraph of Darling's letter.

"The last variety, proving to be the *precise article that I was in pursuit of* I have for three years past kept for cultivation that alone." (Italics ours). How many plant breeders today can say the same at the culmination of a 10 year breeding program?

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TWIN ARMY OFFICERS

THE Giles twins, whose recent promotions to notable positions in the Army have been in the news (see page 258 of this issue), prompted a survey of the distribution of twins among army officers. The *Army Register* for January 1, 1943, contained the names of approximately 13,000 commissioned officers on the active list in the United States Army. It does not list the commissioned officers of the Reserve and other categories in the emergency armed forces. It is thus a roster of those who have made the army a career.

The *Register* is ideally arranged to locate twins quickly. The name of each individual listed is followed by the state of birth and the date of birth according to the army system (day-month-year). Thus it is only necessary to go through the list of names, cross-checking similar surnames which have the same birth state. Only rarely need the numeral following the birth state be considered, so that a quick survey is fairly reliable.

Taking groups of pages at random through the *Register* twenty-four hundred names were checked, which yielded two pairs of twins. This is a ratio of one pair of twins in twelve hundred names. One pair born in 1905 held the ranks of major and of lieutenant colonel. The other pair was born in 1913, and both were majors. Hence their achievement would appear to rate about average.

As was pointed out in the JOURNAL in 1936 (p. 443), the inclusion of both of a pair of twins merely by chance in a list would only occur once in more than sixteen hundred times. Since no fe-

male twins are in this group this would eliminate all female and bisex fraternal twins and female identical twins. A quarter of all twins are identical twins, half of the pairs being female and half male. Among the fraternal a quarter of the pairs are both males. In terms of total twins, this equals one-eighth plus three-sixteenths, or five-sixteenths. If twins comprise one-fortieth of the population (the proportion is considerably less at maturity), then five-sixteenths of this proportion represents one person in 128. This fraction to the second power gives a frequency of one in 16,384, which is the expectation that twin *pairs* would be found in the *Army Register* if their occurrence there were merely by chance. Actually the frequency of twins appears to be over thirteen times as great.

Nothing is known about the zygosity of the other two pairs noted. In the case of the Giles twins, their appearance is so strikingly alike that they almost certainly are identical. Since the frequency of twins in this list so greatly exceeds what would be expected by chance, one might hazard a guess that most army officer twin pairs are identical.

Present conditions preclude investigating this point. Neither is it possible in the *Register* to identify twins only one of whom is an army officer. Since pairs are represented more frequently than would be expected merely by chance it might be argued that twins are more warlike than singlets. Any actual excess probably demonstrates again that identical twins tend to resemble each other in what they do in the world, though to a lesser extent than they mirror each other's appearance.

The history of the Giles twins is interesting in several respects. They were born in Texas on September 13, 1892 (it was a Tuesday, not a Friday!). Both began their military career in World War I, and neither of them went to West Point. It appears from the record that they entered the army at different times and enlisted in different branches of the army. Nevertheless, they were both quickly transferred to aviation and have continued in that service ever since.

Lieut. General Barney McK. Giles entered the army as a private, first class, in the Signal Corps on September 15, 1917. He was commissioned a second lieutenant in April of the following year. He was honorably discharged in 1920 with the rank of first lieutenant, and was reappointed to that rank a few months later. He had reached the rank of major in 1939 and two years later that of lieutenant colonel. In the spring of 1942 he was advanced to the rank of brigadier general and the fall of that year he became a major general. His promotion to the rank of lieutenant general and his appointment as Chief of Staff of the Army Air Forces occurred only a few months ago.

Barry F. Giles entered the army in 1917 as a second lieutenant of Infantry. He transferred to the aviation section of the Signal Corps a month later and was honorably discharged in 1919 with the rank of first lieutenant. He was recommissioned a second lieutenant in the regular army in 1920 and advanced more rapidly than his brother, becoming a major in 1930. In 1939 he was a temporary lieutenant colonel. He was advanced to brigadier general in 1942 and his recent promotion to major general, like his brother, occurred this year. Thus, with minor differences, the histories parallel each other remarkably.

The recent promotions of the Giles twins are of interest because both have been to a higher rank from near the bottom of the preceding grade. On January 1, 1943, there were in the United States Army 19 lieutenant generals, 231 major generals, and 589 brigadier generals. On that date Barney McK. Giles stood 193 on the list of major generals, near the bottom of the roster. General Barry F. Giles was 391 grades below the top among the brigadier generals. Both these jump promotions were made to men who were not West Point graduates. This in itself is unusual. That it has happened to identical twins adds another to that remarkable series of coincidences reported by so many of these pairs of genetically interchangeable human beings.—R. C.

GROWTH HORMONE STUDIES OF SOME DIPLOID AND AUTOTETRAPLOID PLANTS

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IT has been found by many investigators (summarized by Műntzing[1]) that increasing the chromosome number in many plants decreases their rate of growth. Robbins and Kavanaugh[2] found that as the chromosomes were increased from haploid, through diploid to tetraploid in the tomato, there was a decrease in growth in length of excised roots. The difference was not great between the haploid and diploid plants, but the tetraploid grew much less. The dry weight was also less than that of the others. Rate of cell division is also known to be slowed down. Findings of this sort have led the author to investigate the relation between the growth hormone content and the chromosome number of several plants. If the rate of growth is slowed down one might expect a decrease in the growth hormone content too, with an increase in the chromosome number.

Material and Methods

Not being a geneticist and being only casually acquainted with genetical work the author had considerable difficulty in obtaining the proper material. As the hormone content varies considerably in plants it was absolutely necessary to use related material. It was therefore decided to use diploids and their autotetraploids. Two varieties of Marigold (*Tagetes*), Guinea Gold and Golden West, and the cherry tomato (*Lycopersicum pimpinellifolium*) have been used. The diploid and the related tetraploids have been used when at the same stage of development and on the same day, so that the comparisons are valid. Several different stages of development of the plants have been analyzed to insure further the accuracy of the work.

The plant material was harvested, frozen with dry ice, ground and thoroughly mixed while frozen. Then three or four equal lots of the same material were weighed, placed in 500 ml. Erlenmeyer flasks, and about 200 ml. of freshly distilled ether added. The flasks were placed in a cool room at 15° C. About 24 hours later the ether was poured off and the material washed several times with fresh ether. Fresh ether was added to the material in the flasks which were put back in the cool room for 48 hours. The ether with the extract was evaporated down and finally drop-pipetted into a small vial. Each lot was of course handled separately. After 48 hours a second extract was obtained and it was handled in the same way. Thus from each lot of material two extracts were obtained. These were tested the day following their tubing. Experiments in this laboratory have shown that there is no hormone deterioration during a period of several days, nevertheless we are in the habit of using an extract within 24 hours after it has been evaporated down to dryness.

Several lots of the same material are used because it is necessary to use dilutions (concentrations of hormone) which show a proportionality between concentration of hormone and curvature in *Avena* coleoptiles. The curves in Figure 3 show that only by a series of dilutions is this possible. The term dilution is used because one knows nothing about concentrations in these experi-

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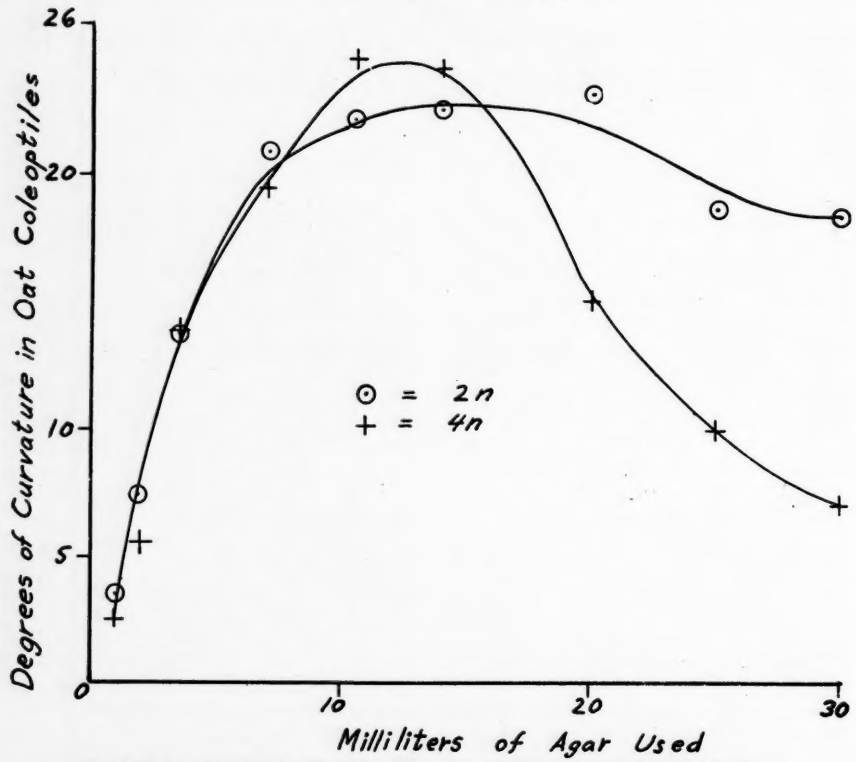

DILUTION CURVES OF DIPLOID AND TETRAPLOID MARIGOLDS

Figure 3

Extent of curviture in oat coleoptiles induced by progressive dilutions of extractions from autotetrapoind and "parent" diploid marigold plants. At the higher concentrations the proportion of growth hormone is above the optimum in both groups. With progressive dilutions the differences between the concentrations in diploid and tetraploid become evident. The more rapid falling off of the tetraploid curve indicates that the hormone is less concentrated in this form.

ments, and dilutions are spoken of in terms of the amount of agar that has been added directly to an extract or to an aliquot of a dilution. By making several dilutions from each lot of material many different concentrations may be obtained. Thus in experiment 249 with Guinea Gold, illustrated by Figure 3, nine different concentrations or dilutions were obtained. The procedure may be further clarified by giving the details of this experiment. To lot one was added 1.0 ml. of agar, to lot two 2.0 ml., to lot three was added 3.5 ml. and further dilutions of 7.0, 10.5 and 14.0 ml. of agar were prepared from this lot. Lot four was diluted with 5.0, 20.0, 25.0 and 30.0 ml. of agar. It will be noticed that not until a dilution of 14.0 ml. was made with the teteraploid and 20.0 ml. with the diploid was the maximum curvature reached and only after further dilutions was there a decrease in the curvature of the *Avena* coleoptiles and a differentiation between the two kinds of plants. Any dilution below that of 20.0 ml. of agar would not have brought out the true state of affairs as to the relative amount of hormone in the two kinds of plants.

In experimentation of this kind large numbers of *Avena* plants are necessary. In the experiment cited 26 rows each of 12 seedlings were used, because dilutions thought to be critical were run with two rows (24 seedlings), and two rows of control with indoleacetic acid were also included.

The amount of hormone was determined with *Avena* in the usual way. Since considerable criticism has been directed against Van Overbeek's method of calculating hormone concentration it was decided to avoid using his method. Therefore the materials to be compared were used at the same time and both were diluted to the same extent. In this way it is possible to make direct comparisons between the diploid and tetraploid plants. This method of procedure can be employed only when not too many different plants are to be compared so that they can all be used the same day.

Results

In presenting the data the curvature obtained in *Avena* seedlings with the autotetraploid extract is calculated as a percentage of the curvatures obtained with the extract from the diploids, for the same dilution. The averaged curvatures obtained with extracts from the diploid are taken as 100 per cent. Only curvatures obtained with dilutions which are shown to be within the range of proportionality have been used.

From the tables and from Figure 3 it will be seen that in all three strains there was considerably less hormone in the tetraploids than in the diploids. The irregularities shown in places in the tables are partly due to the fact that in the lower dilutions the hormone in the diploid was too concentrated and the curvature therefore was not proportional to the hormone concentration, while in the tetraploid with a lower hormone content this relationship existed. Other irregularities are due to the fact that the results for the several lots of plants in each experiment are arranged according to increase in dilutions rather than according to dilution within a lot of material.

The general appearance of the plants gives no hint that the tetraploids have a lower hormone content. If anything,

Tables I-III. These tables report the growth hormone activity of progressive dilutions of ether extracts of diploid plants and of tetraploids derived from them. Dilution is achieved by adding measured quantities of agar (in milliliters) to the dried extract of a weighed sample of plant tissue. The results are expressed as the percentage of curvature induced in Avena seedlings by the autotetraploid material as compared with the curvature induced by paired diploid material diluted to the same extent.

TABLE I. In Experiment 237 vegetative stem tips of greenhouse grown plants of *Lysopersicum pimpinellifolium* were used. In experiments 242 and 243 stem tips with leaves and flower-buds of field-grown plants were used.

Exp. 237		Exp. 242		Exp. 243	
ml. agar	4n curv	ml. agar	4n curv.	ml. agar	4n curv.
1.6	43.6	4.0	83.0	8.0	44.2
3.2	25.3	8.0	80.0	14.0	33.1
6.0	18.3	12.0	75.00	9.0	85.2
				12.0	80.7

In the three experiments the mean curvature of the oat seedlings produced by the extract from the tetraploids was only 56.84 per cent of that produced by the diploids.

TABLE II. Golden West Marigold. In Experiments 244 and 246 only the vegetative tips of field-grown plants in blossom were used. In Experiment 257 only the flower buds of greenhouse plants were used.

Exp. 244		Exp. 246		Exp. 257	
ml. agar	4n curv.	ml. agar	4n curv.	ml. agar	4n curv.
14.0	87.8	5.5	79.4	5.0	74.0
20.0	92.1	8.0	84.6	6.0	82.0
		14.0	50.0	7.5	56.7
		18.0	80.0		

In the three experiments the mean curvature produced by the extract from the autotetraploids was only 76.3 per cent of that produced by the extracts from the diploids.

TABLE III. Guinea Gold marigolds. Plants used in Experiments 239 and 256 were from the greenhouse—vegetative growth was used. Plants for experiments 248 and 249 were field-grown; flower buds were used in 248 and leaves from plants in flower in 249.

Exp. 239		Exp. 248		Exp. 249	
ml. agar	4n curv.	ml. agar	4n curv.	ml. agar	4n curv.
2.0	67.7	5.0	91.2	20.0	64.1
4.0	67.3	10.0	51.8	25.0	59.2
6.0	42.4	15.0	30.6	30.0	38.8
7.5	47.2				

Exp. 256	
ml. agar	4n curv.
2.5	84.2
4.0	90.0
5.0	66.0
7.0	18.7

In the four experiments the mean curvature produced by the extract from the autotetraploids was only 51 per cent of that produced by the diploids.

the tetraploids look more vigorous, at least when young. The leaves are larger and in the marigolds the flowers are also somewhat larger than in the diploids. In all three plants the diploids blossom considerably earlier than the tetraploids, which is perhaps a sign of slower growth as well as of later maturing in the tetraploids. The tetraploid marigold seeds have the appearance of being larger and the very young seedlings are definitely stockier. In two experiments on germination the tetraploids seeds germinated slightly earlier than the diploids.

Summary

It has been found that the autotetraploid marigold, Guinea Gold, has 58.1% as much growth hormone as the diploid; the autotetraploid of the marigold, Golden West, has 76.3% as much as the diploid and the autotetraploid of *Lycopersicum pimpinellifolium* has 56.84% as much as the diploid.

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Heredity and Stuttering

IF the totals of the deaf, the blind, and the insane are added, the sum is considerably smaller than that of the number of men, women, and children who suffer from stuttering. Baffling in its manifestations, stuttering is called a sex-factor disorder. For example, statistics on sex-factor disorders tell us that there are approximately three times more women than men afflicted with gall stones; Daltonism or color blindness is veritably nonexistent among the female sex; likewise, hemophilia, or bleeding sickness, is a so-called male disease because only boys and men are afflicted with it. There is approximately nine times more stuttering among men than women. * * *

If one were to select one hundred stutterers at random and match them with non-stutterers in regard to age, intelligence, social background, and other such factors, and then trace the speech characteristics of the forebears of both groups, one would probably find six times as many stutterers in the ancestors of the stuttering group as in those of the non-stutterers. In families in which twins tend to recur one may expect to find about five times as many stutterers as the generally anticipated number. Such findings point to heredity as the chief predisposing cause of stuttering. * * *

Much has been written about the forced change of left-handedness as a cause of stuttering. The theory is based on the knowledge that the left side of the brain controls the movements of the right side of the body, and conversely, the right side of the brain controls the left side of the body. It is also based on the hypothesis that the side of the brain that controls the preferential hand, especially in writing, also is the dominant factor in controlling the co-ordinated muscular movements which produce fluent speech. Hence, if handedness is changed by force, stuttering is said to result frequently. Results of surveys do not bear out the contention that all, or most, stuttering is caused by forced change of handedness. In one of the studies that involved 89,000 St. Louis school children, "the vast majority of our lefthanded pupils who have been taught to write with the right hand had not developed any speech defects." Moreover, 81.4 per cent of the children for whom definite data were supplied began to stutter before they were given any instruction in writing in the schools." Nevertheless, most psychologists and educators today do not advise the forced change of handedness. "Let nature takes its course in this respect" is their advice.—JAMES F. BENDER, *Sci. Mo.* 59:221, 1944.

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Genetics and Medicine

The time is ripening for the application of genetics to the study of human disease and normal human physiology. As a natural concomitant of increasing knowledge of human heredity, I believe we shall see a growth in the so-called "constitutional medicine" and that facts so obtained will illumine not only disease but the innate functional capacities characteristic of different persons.

Possibly medical research will, in the next decade or two, hold up its method of thought to critical review and analysis. I find the level of interpretation of data so painfully low that, for example, I should like to hear no one attribute a condition to any cause without being obliged to specify whether he meant the cause to be understood as the predisposing, the precipitating, or the perpetuating cause. If, as Francis Peabody insisted, a scientist is known by his mental processes, I believe that explicit and detailed research on the mental processes appropriate in medicine would bring great returns to research if only in the discipline it would establish.—DR. ALAN GREGG, in the *Scientific Monthly*, 58:365. 1944.

THE CATTLE OF INDIA

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THE importance of cattle in India was stated succinctly by Lord Linlithgow, former viceroy of India, when he observed that "The cow and the working bullock bear on their patient backs the whole structure of Indian agriculture." India is primarily an agricultural country, and approximately 90 per cent of the population of over 350 million people live on the land. The bullock is the only important source of power on about 300 million acres of cultivated land and is also the major road-transport animal. Most of the people are vegetarians, depending on milk and milk products as the source of animal protein in their diets.

Owing to the great importance of cattle in the economy of the country, it was only natural that a considerable amount of attention was given to cattle breeding in past centuries. There apparently had been little organized effort to improve the cattle of the country until recent years. However, a number of useful types and breeds had been developed in various regions and, owing to the vastness of the country and difficulties of transportation, many of these types and breeds were maintained in reasonably pure form. There is a marked difference in quality between the ordinary village cattle and these improved types, which are localized to a considerable extent.

Owing to their adaptability to a hot climate and to their relatively high resistance to droughts, to cattle pests and to a tropical environment generally, Indian cattle have been exported to various tropical and sub-tropical countries, including several South American countries and the Gulf Coast region of the United States.

Cattle of Indian origin are commonly referred to in the United States as "Brahman" cattle, and Parr[8] reports that the U. S. Department of Agriculture's committee on terminology adopted this as the preferred name of the species *Bos indicus,* the humped cattle of India. The term "Zebu" is also used to designate this species. Parr[8] has described four breeds of Indian cattle, designated as the Gir, Guzerat, Krishna Valley, and Nellore breeds, and Black[1] states that Indian cattle imported into the United States were mostly of these breeds. A résumé of the utilization of these cattle in the gulf coast area is given by Rhoad and Black.[10] The names Guzerat (Gujarat) and Nellore apparently refer to portions of the geographic areas from which animals were imported and the names commonly used for these two breeds in India are Kankrej and Ongole, respectively.

Classification of Indian Cattle

Actually, there are several diverse types of cattle in India and many breeds are commonly recognized within some of these types. Hence, the inclusive terms, "Brahman" or "Zebu," as they are commonly used in the United States to indicate Indian cattle, are adequate only to indicate the species *Bos indicus* as distinct from *Bos taurus,* and other terminology is needed to indicate the types and breeds. This paper was prepared to make available to American scientific workers and livestock producers interested in the utilization of Indian cattle a brief description of the generally recognized types and breeds in India.

Some of the so-called breeds are probably not sufficiently distinct to justify being so classified. This problem is now

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being actively considered by Indian authorities, *i.e.*, the Imperial Council of Agricultural Research, along with their efforts to describe in detail the various breeds. No attempt will be made here to solve the problem of what is and what is not a breed, but some obvious similarities will be noted. The Imperial Council of Agricultural Research has recently established an office to care for the registration and the recording of milk production in certain breeds of cattle and water buffalo. This work is described by Kartha.[4]

Types of Indian Cattle

Oliver [7] and Ware[13] have presented classifications of the types of Indian cattle. They are in general agreement but differ in some details and on the proper classification of certain breeds. The classification presented below, adapted from those mentioned above, is used here for convenience in grouping the breeds, recognizing that much study is needed before any such classification could be considered final.

Group 1

Figure 5

These are lyre-horned gray cattle with wide foreheads, prominent orbital arches, the face having a flat or dished-in profile. Ware[13] includes the Kankrej, Malvi, and possibly the Tharparkar in this group. The Hissar, Kenwariya and Kherigarh have not been classified by Indian workers but appear to fit into this group reasonably well.

Group 2

Figures 6-7

These are short-horned white or light-gray cattle with a long coffin-shaped skull, orbital arches not prominent, and with the face slightly convex in profile. Oliver[7] includes these along with group 1 under the general description of "large white cattle of the north" but recognizes the two groups as sub-groups. The Bhagnari, Hariana, Krishna Valley, Mewati, Nagori, Ongole and Rath breeds are included in this group by Ware.[13] The Gaolao appears to fit into this group also, and is so listed by Oliver.[7] The Bachaur has not been classified but also appears to belong with this group on the basis of limited information available. In the animals of both groups 1 and 2, the usual tendency is for males to be some shade of gray over the neck, shoulders, hump and quarters, becoming darker with age, while females are of a lighter shade and eventually become white or nearly so with age.

Group 3

Figure 8

These cattle are of more ponderous build than those of other groups, and have a pendulous dewlap and sheath, prominent forehead and lateral and often curled horns. They are usually spotted, either red and white or brown and white, but some breeds such as the Sindhi are solid or nearly solid brown or red. In India they are usually referred to as "dairy type" animals. Ware[13] lists the Deoni, Gir, Nimari, Sahiwal and possibly the Red Sindhi in this group. Oliver[7] points out that the Red Sindhi and Sahiwal probably originated from Afghan cattle with some admixture of Gir blood. The Dangi breed, which is similar to the Deoni, also appears to fit best into this group.

Group 4

Figure 9

The cattle of this group are medium-sized, compact animals with tight sheaths, very prominent foreheads, and long pointed horns arising close together. They are usually gray in color. Included in this group are the Alambadi, Amrit Mahal, Bargur, Hallikar, Kangayam and Khillari. The term "Mysore cattle" is sometimes used to describe this type.

Group 5

Figure 10

These are small, short-horned cattle with tight sheaths. The poll and hump may be covered with coarse hairs. The color is usually black or some shade of red (deep red to light dun), and many have white markings. They are found all over India and particularly in the Himalayas, in the hills of Baluchistan

LOCATION OF INDIAN CATTLE BREEDS

Figure 4

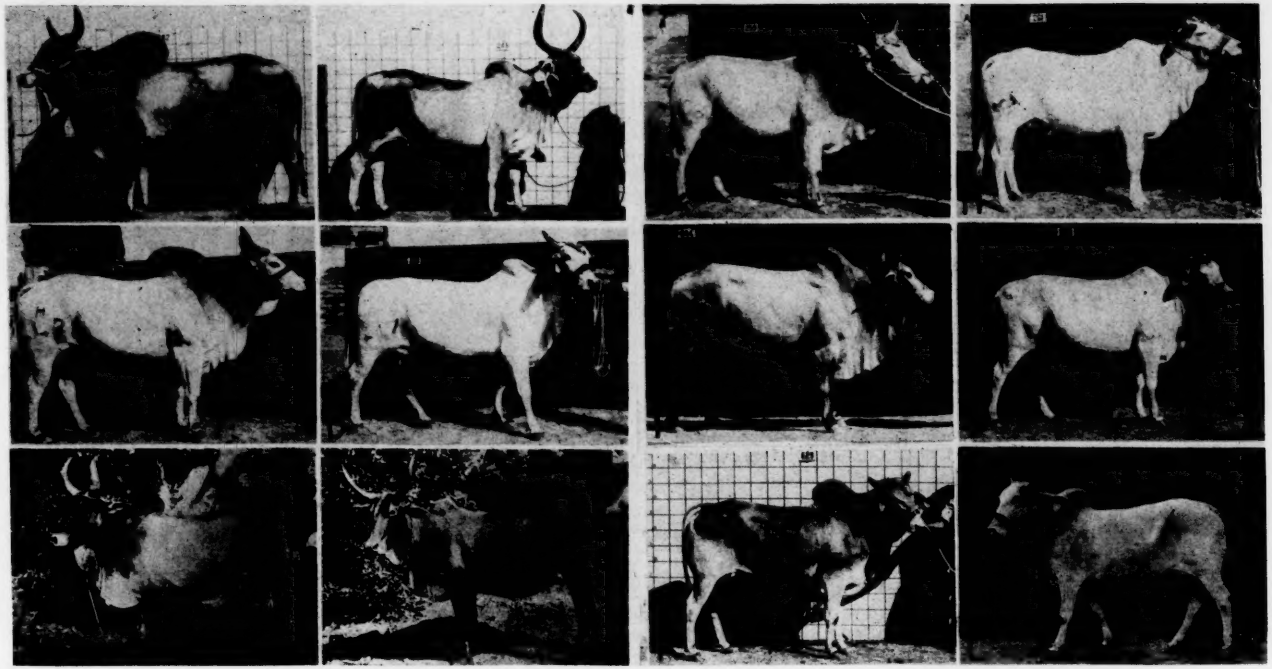
This outline map shows approximately the locations of breeds discussed in this paper. In general, the breeds in groups 1, 2, and 3 are found in Northern and Central India. Group 4 breeds are limited to Southern India, and groups 5 and 6 are found mainly in Northern India, except the small village cattle of group 5, which are found in many parts of the country.

and in poor forest tracts. Distinct breeds are not so generally recognized in this group, but some of the types included are Lohani, Ponwar and Siri.

Group 6

Figure 11

The animals of this group are medium-sized, compact and active. The head is of moderate size, with small horns which emerge laterally from a distinct poll and curve upwards and outwards. The dewlap and sheath are tight. Coloring in most animals consists of black or red spots on a white coat, varying from almost white animals with evenly scattered spots over the whole body (similar to the Dalmatian dog) to animals that are predominantly black with the typical spotting visible only on certain parts. This group is represented only by the Dhanni breed, which is recognized as being a distinct type by both Oliver[7] and Ware.[13]



GROUP 1 BREEDS

Figure 5

The cattle classified in group 1 are lyre-horned gray animals with wide foreheads, prominent orbital arches and with a flat or dished-in profile. *A* and *B* show a bull and a cow respectively of the Kankrej breed. They are very powerful draft cattle, and the milk production of the cows rarely exceeds 3,000 pounds. *C-D* are a Hissar bull and cow, a draft breed developed by the Punjab Government over a century ago. *E-F* are a Kenwariya bull and cow; small, fairly powerful draft animals, the cows are poor milkers. The Kherigarh breed (*G-H*) is used for light draft and trotting purposes; the cows are poor milkers. The Malvi (*I-J*) is a Central Indian breed used for draft purposes. Tharparkar cattle (*K-L*) are found in the semi-desert region of southwest Sind. The bulls are good workers and the cows fair milkers.

Breeds of Indian Cattle

The breeds that are generally recognized in each of the groups listed above are described briefly below. Approximate locations of the native homes of the various breeds are indicated on the map in Figure 4. Photographs of animals of the various breeds are presented in the other figures. In most cases, these are of animals selected as reasonably outstanding individuals.

Group 1

Kankrej

The home of this breed is to the southeast of the Rann of Kutch extending from the southwest corner of the Tharparkar district of Sind to Ahmedabad in Bombay province, and from Deesa in the east to Radhanpur State in the west. In Radhanpur State it is known as the Wadhiar breed. They are exported to other areas for draft purposes, and especially to Kathiawar and Baroda States and to Surat. They are fast, powerful draft cattle; and the cows produce some milk. Kothavalla[5] lists milk records varying from 1371 to 6719 pounds per lactation. Under village conditions production rarely exceeds 3000 pounds. The Imperial Council of Agricultural Research[2] has published 54 records from cows bred at recognized farms that averaged 3159 pounds in 303 days. This is the breed that has been imported to the United States in the greatest numbers. High carriage of the head, long, drooping ears, well-developed hump, heavy skin, moderately heavy dewlap, rather pendulous sheath and comparatively short tail with black switch are characteristics of this breed. Hide, covered with hair, usually extends one to one and a half inches along the bases of the horns in both bulls and cows.

Hissar

This breed is also called Hissar-Hansi, these being the names of two cities in Punjab, in the vicinity of which it was developed. It was developed primarily through the efforts of the Government Cattle Farm, at Hissar, which was established in 1809 and has been used as a cattle-breeding station since 1815. Reports indicate that bulls of several types were brought to this farm and were used there and in the area on the local Hariana cows, to produce larger, stronger animals for draft purposes. The appearance of most of the animals now seen indicates that Kankrej bulls had the dominant influence in developing the new type. This breed is, in general, intermediate to the Kankrej and Hariana but is still quite variable. Present policy of the Government Cattle Farm at Hissar is to discontinue work with the Hissar breed and to concentrate on the indigenous Hariana breed, not only at the farm but for extension into the surrounding territory, hence it seems probable that the so-called Hissar breed will gradually disappear.

Kenwariya (Kenkatha)

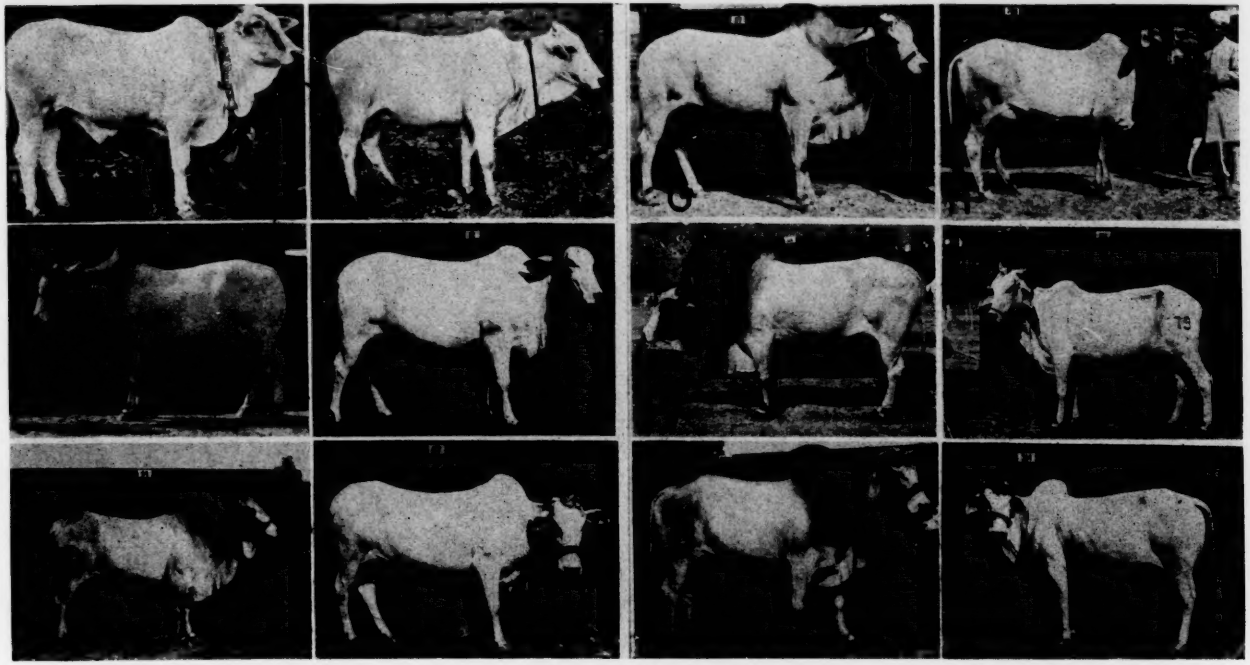
This breed is found along the Ken river in Banda district of the United Provinces. Cattle of this type are also bred in the territory of Panna, Bijaigarh, Charkhari and Ajaigarh States of Central India. The animals are small, sturdy, and fairly powerful. Cows are poor milkers. Color varies from gray on the barrel to dark gray on the remainder of the body. Ears are sharp-pointed. The sheath is somewhat pendulous and the dewlap is moderately heavy.

Kherigarh

This breed is found in Kheri district of the United Provinces. The animals are generally white, have a small narrow face and thin upstanding horns. They are active and good for light draft and trotting purposes. The cows are reported to be poor milkers.

Malvi

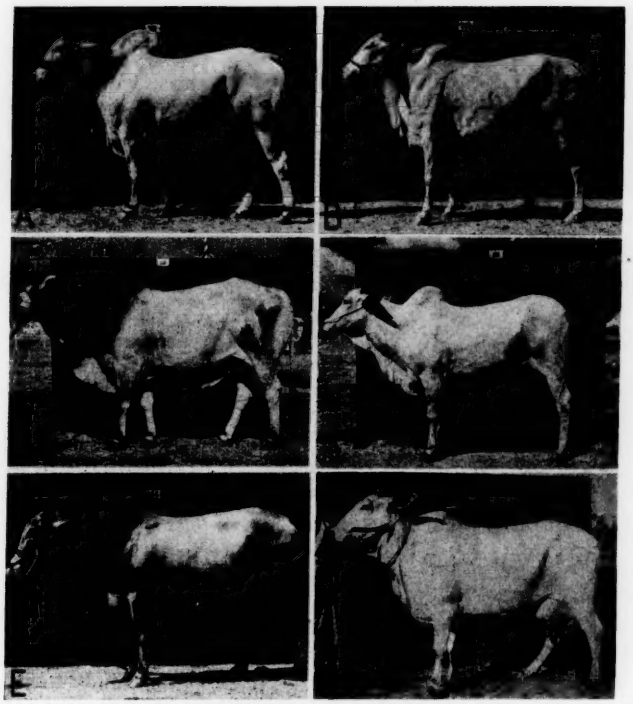
This breed is found in Gwalior State, States of Central India and in Hyderabad States. The best animals are reported to be found in the Malwa tract of Central India. Considerable variation in type is reported in the different areas. Oliver[7] reports that there is a large type in the southwest of Gwalior State and



GROUP 2 BREEDS

Figure 6

These are white or light gray cattle with long coffin-shaped skulls. In this group are some of the best draft and trotting cattle of India. *A-B*—Bachaur bull and cow, a draft breed giving little milk. The Bhagnari breed (*C-D*) is mainly used for draft purposes. The cows are said to give a fair amount of milk. Gaolao cattle (*E-F*) comprise the most important breed in the Central Provinces. The bullocks of the Hariana breed (*G-H*) are powerful work animals; the milk production of the cows averages around 3,000 pounds per year. The Krishna Valley cattle (*I-J*) are also a dual-purpose breed. These powerful-muscled bulls are used for slow draft work and heavy plowing. The cows are fair milkers. The Mehwati breed (*K-L*) resembles the Hariana, with some mixture of Gir blood (see Figure 8 *E-F*).



OTHER GROUP 2 BREEDS

Figure 7

Nagori cattle (*A-B*) are one of the most famous trotting breeds in India. The cows give little milk. The Ongole cattle (*C-D*) are found in the Madras Presidency. They are used for heavy work. Some of them have been imported to the U. S. A. where they are called Nellore cattle. Milk yield varies greatly from a few hundred pounds to over 5,000 pounds per lactation. Rath cattle (*E-F*) are powerful medium-sized animals adapted to moderately heavy draft work. They are similar to the Hariana, but somewhat smaller.

the surrounding area, and a small type southeast of this area. In general, they are massively built, compact animals. Color is gray, deepening in the mature male to a dark iron gray on the neck, shoulders, hump and quarters.

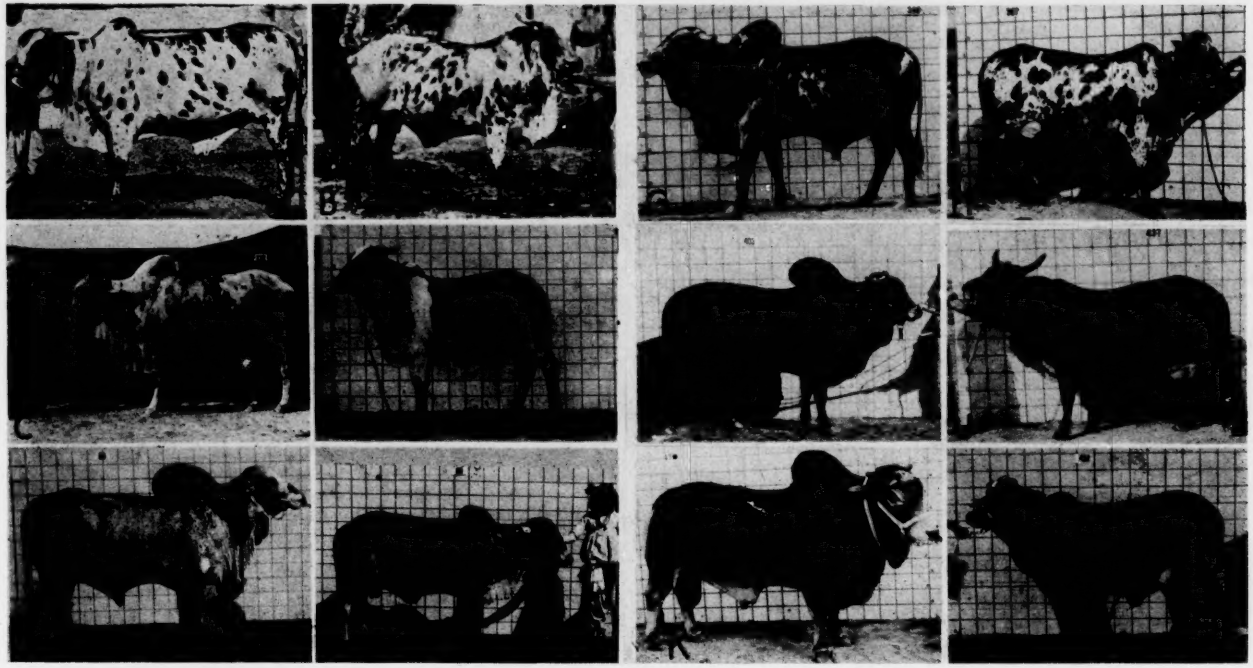
Tharparkar

This breed is found in the arid, semi-desert tracts of southwest Sind and adjoining regions of Cutch, Jodhpur and Jaisalmer. They are medium-sized animals of compact build. Bullocks are good workers; cows are fair milk producers. Kothavalla and Kartha[6] list lactation records varying from 949 to 6948 pounds of milk, and 21 of the 51 records are above 4000 pounds. The Imperial Council of Agricultural Research[2] has published 109 records from cows bred at recognized farms that averaged 4,056 pounds in 267 days and 29 records from purchased cows that averaged 3,597 in 261 days.

Group 2

Bachaur

The home of these cattle is in Bachaur and Koilpur areas of Sitamarhi district in Bihar, where herds are grazed in the forest area during the day. This is essentially a draft breed and Ware[13] reports that the average milk yield is



GROUP 3 CATTLE

Figure 8

Breeds in this group are of a heavier build than any other group and often have curled horns. They usually have brown or red spots on a white background. In India they are referred to as "dairy type" animals. The Dangi breed (*A*, bull—*B*, cow) is found in western Bombay Province. The bulls are good workers, but the cows produce little milk. Deoni cattle (*C-D*) are found in the northern and western portions of Hyderabad State. The bullocks are used for heavy cultivation and the cows are reported to be the best milkers in that region. They resemble the Gir breed in many respects. Gir cattle (*E-F*) are found in purest form in the forest of that name in Southern Kathiawar. The leaf-like ears, notched near the tip, are characteristic. The slow and lethargic bullocks are used for draft purposes. Selected cows average nearly 4,000 pounds of milk in a lactation. Nimari cattle (*G-H*) are a cross between Gir and Khillari cattle, and are not a fixed breed. Red Sindhi cattle (*I-J*) are found around Karachi in Northwest India. This is one of the better milking breeds. The Sahiwal cattle (*K-L*) is an important milk breed in the central and southern Punjab. The bullocks are used for heavy draft work.

only two to four pounds per day. The prevailing color is gray. The forehead is broad, with prominent eyes, and the ears are large and drooping. The sheath and dewlap are not highly developed.

Bhagnari

The home of this breed is in the Bhag territory north of Jacobabad in Baluchistan, and in the adjoining area of Sind. A small type is recognized in the Nari Valley around Jacobabad and a larger type in the upper Nari Valley. The color is gray or white, and in mature males the neck, shoulders and hump may be nearly black. The animals of this breed are comparatively long-bodied, well-muscled, and are reputed to give a fair amount of milk.

The so-called Dajjal breed, found in the Dera Ghazi Khan district of the Punjab, is an offshoot of the Bhagnari, resulting from the importation of bulls into this area. The first bulls were taken to that area about 100 years or more ago.

Gaolao

This is the most important breed in the Central Provinces, the best animals being found in the Wardha and Chindwara districts. The animals are of medium height, of rather light build, and tend to be narrow. Females are usually white and the males gray over the neck, hump and quarters. The head is markedly narrow, with a straight profile, and is rather broad at the base of the horns and tapers toward the muzzle. Horns are short and stumpy, blunt at the points, and usually slope slightly backwards. The dewlap is large and the sheath is moderately large.

Hariana

This breed is produced primarily in the Rohtak, Hissar, Karnal and Gurgaon districts of the Punjab and in Delhi province. Animals of the same general type are also produced over a large area to the south of the main Hariana tract, and particularly in the eastern portion of the United Provinces. The bullocks are powerful work animals and the cows produce a fair amount of milk. Data obtained in rural areas indicate that the cows average approximately 3,000 pounds of milk. Smith[11] and Kothavalla and Kartha[6] present data showing a range in production per lactation from 1,562 to 6,742 pounds of milk. The Imperial Council of Agricultural Research[2] has published 81 lactation records from cows bred at recognized farms that averaged 3,426 pounds in 308 days and 26 records from purchased cows that averaged 3,286 in 298 days. The head is long and narrow, with a flat forehead and well-marked bony prominence at the center of the poll. The horns are never heavy and are often stumpy. The dewlap and sheath are small.

Krishna Valley

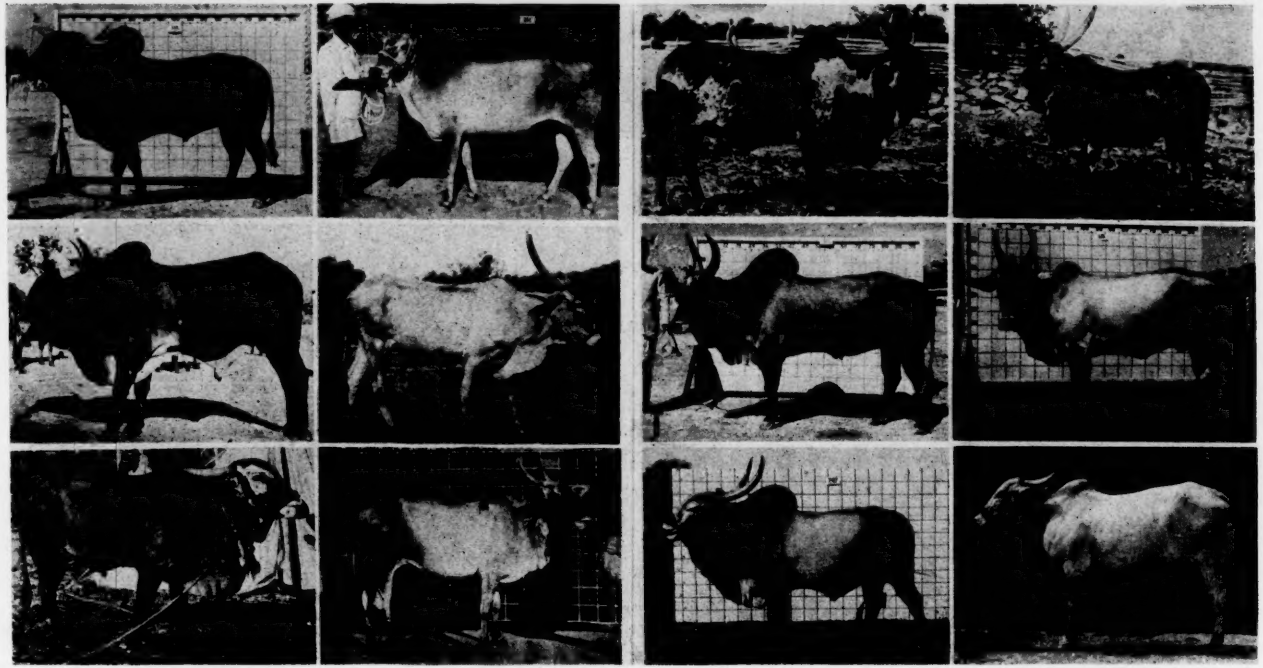
The home of this breed is in the southern portions of Bombay Province and Hyderabad State. The bullocks are massive, powerful animals, useful for slow draft and for heavy ploughing; the cows are fair milkers. The breed type is not well fixed and considerable variation occurs. The coloring and general characteristics indicate that large, gray-white cattle of the north are the basis of this breed, but there is some evidence of blood of the Mysore type (group 4). The sheath and dewlap are moderately developed.

Mehwati

These cattle (also called Kosi) are bred in large numbers in the western portions of Alwar and Bharatpur States and are valued as powerful, docile cattle, useful for heavy ploughing and carting. They are similar in type to the Hariana, but show definite evidence of an admixture of Gir blood. The usual color is that of the gray-white breeds, but some individuals of Gir coloration appear. The head is comparatively long and narrow, with a somewhat bulging forehead. The sheath and dewlap are moderately developed.

Nagori

This is one of the most famous breeds of trotting draft cattle in India, and its home is in the northeast portion of Jodhpur State. Bullocks are large and



GROUP 4 BREEDS
Figure 9

Breeds in this group are popularly termed "Mysore cattle." They are characterized by prominent foreheads and long, pointed horns arising close together. They are, with few exceptions, poor milkers. The Hallikar breed (*A*, bull—*B*, cow) appears to be the basic stock from which the other so-called breeds in this group have been derived. Alambadi cattle (*C-D*) differ so little from the Hallikar that it is a question whether they are a separate breed. The Amrit Mahal (*E-F*) were developed in Mysore for use in warfare. Though not large, they are wiry and famous for their powers of endurance. Closely related are the Bargur cattle (*G-H*) of Madras Province. They are smaller, have less prominent foreheads, and are nervous and difficult to train. The Kangayam breed (*I-J*) of the Madras region is very similar to the Mysore type. Though of moderate size, they are active and powerful and are highly prized as draft animals. The Khillari breed (*K-L*) is found in southern Bombay Province. There is evidence of infusion from the gray-white cattle of the north. The type is not uniform.

are much prized for fast road work. The face is long and narrow and the forehead is usually flat. The dewlap and sheath are small. The cows are reported to give little milk.

Ongole

These cattle are found in the Madras Presidency. They are much valued for heavy work, but are not considered suitable for fast trotting. The most important center of production is the Guntur district. Animals of this breed have been exported in considerable numbers to northern South America and other tropical areas. Some of these animals (usually referred to in the U.S.A. as Nellore cattle) have been brought into the southern portion of the United States. These animals are of large size and quite muscular. Bulls weigh as much as 1,800 pounds, according to Smith and Littlewood.[12] The average weight of cows is from 800 to 900 pounds and bullocks in working condition average from 1,200 to 1,300 pounds. These workers record milk yields varying from a few hundreds up to 5,012 pounds per lactation; the majority of the cows tested yielded under 3,000 pounds. The Imperial Council of Agricultural Research[2] has published nine records from cows at recognized farms that averaged 3,164 pounds in 303 days. The dewlap and sheath are of moderate size. The forehead is relatively flat, but a tendency to bulge and the occurrence of mottled patches on the skin under the white hair indicate some admixture of blood of southern Indian breeds. In general, this breed is similar to the large gray-white breeds of northern India.

Rath

This breed is found in the north and west of Alwar State and in adjacent portions of other Rajputana States to the north and west of it. They are also bred outside these areas but are liable to be mixed with the Nagori, Hariana and Mehwati breeds. They are medium-sized, powerful animals adapted to moderately heavy plough and road work. In basic characteristics, this breed is similar to the Hariana, but is somewhat smaller. The dewlap and sheath are small.

Group 3

Dangi

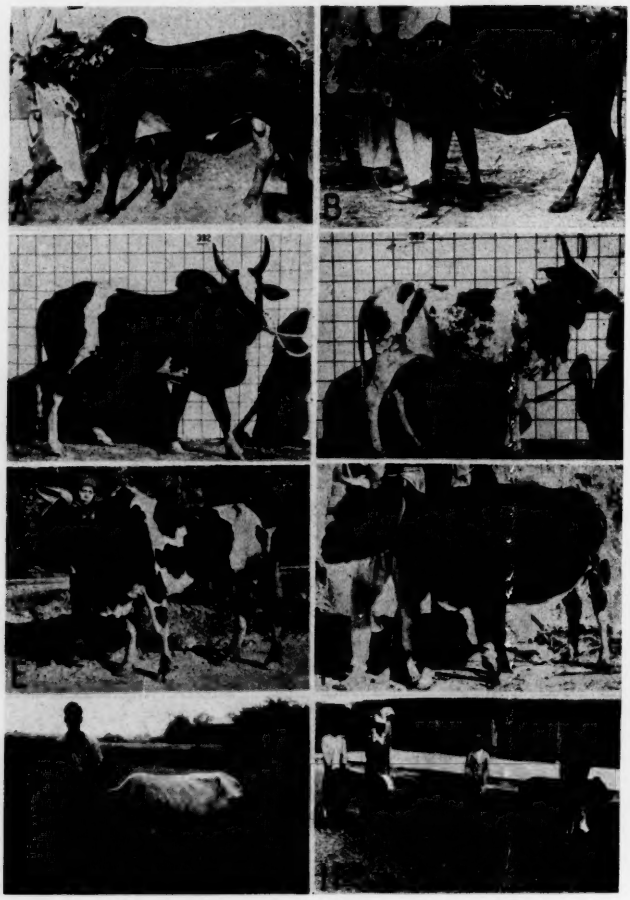
This breed is found in a small area comprising part of Ahmadnagar and Nasik districts in Bombay Province and the States of Bansda, Dharampur, Jowhar and Dangs. It is reported to do well in areas of heavy rainfall and is considered adapted for use in the rice fields. It is a moderately active draft animal. Bullocks are considered good workers, but milk production by cows is low. The skin is said to contain an excessive amount of oil that gives protection from rain. The head is usually small, with a slightly protruding forehead and large muzzle, but there is considerable variation. Horns are usually short and thick. The colors are red and white, and black and white, the red or black being distributed in uneven spots over the body.

Deoni

This breed, which is confined mainly to the northwestern and western portions of Hyderabad State, appears to be allied to the Dangi breed. It is of medium size and bullocks are suitable for heavy cultivation. The cows are reported to be the best milkers in Hyderabad State. The Deoni resembles the Gir breed but it has been bred under different conditions and along different lines. It lacks the long, leaf-like ear and the forehead is less prominent than in the Gir. Black and white, and red and white are the most common colors, the black or red being distributed in irregular patches over the body. The ears are drooping. Horns usually curve outward and backward. The sheath and dewlap are moderately heavy.

Gir

The home of this breed is in the Gir forest of southern Kathiawar and it is found in its purest form in this area. Less pure forms are found in western Rajputana, Baroda and the northern section of Bombay province. Some animals are entirely red, but the color is



GROUP 5 BREEDS

Figure 10

These are small cattle, usually red or black, frequently with white markings. They are found particularly in the Himalayas and in the hills of Baluchistan. The Lohani breed (*A*, bull—*B*, cow) are found in the Northwest Frontier Provinces. The cows are said to yield up to ten pounds of milk per day. The Ponwar breed (*C-D*) is found in the northern and western portion of the United Provinces. They are small cattle, the bulls weighing up to 800 pounds; the cows give little milk. The Siri breed (*E-F*) is said to come originally from Bhutan. Bullocks are good workers and the cows are said to produce a fair amount of milk. All over India so-called village cattle are found. These are small nondescript creatures. One shown here (*G*), a mature cow from Bengal, stands only waist high. Even smaller are the hill cattle (*H*). These shown are from the Himalayan foothills of Northern Indian and are mature animals. They are hardly larger than well-developed goats.

usually mottled and varies from yellowish red to almost black. Some strains are nearly white, with a few spots of color. A peculiarity of this breed is that here and there on most animals, a well-defined patch of color is found that is of a quite different shade from other colored areas on the same animal. The eyes are usually overhung with a prominent forehead. The ears are markedly long and pendulous, opening to the front and resembling a curled-up leaf, with a notch near the tip. The dewlap is only moderately developed but the sheath is usually pendulous. Bullocks are large and powerful and are widely used for draft, but are rather slow and lethargic. The Imperial Council of Agricultural Research[2] has published 11 records from cows, bred at recognized farms, that averaged 3,721 pounds in 333 days and 11 from purchased cows that averaged 3,980 in 374 days.

Nimari

These cattle are bred in the Narbada river valley. They are not a fixed breed, but are the result of cross-breeding between the Gir cattle of Rajputana and the Khillari cattle of the area south of the Narbada. The usual color is red, with large splashes of white on various parts of the body. The horns are intermedite in shape and size between the Gir and Khillari. The forehead is somewhat bulging. The dewlap and sheath are moderately developed and the sheath tends to be pendulous.

Red Sindhi

The home of this breed is the country around Karachi and northwest of it, including the Las Bela area of Baluchistan. In the cattle around Karachi there is evidence of Gir blood and possibly some from Afghanistan, while in the Las Bela area there has been less opportunity for mixing, and the general characteristics and coloring indicate that they are, in the main, a selected type originating from the small hill cattle. The color is red or fawn, frequently with some white on the face and dewlap. The dewlap and sheath are somewhat heavy. The udder is well developed and this is one of the better milking breeds in India. The Imperial Council of Agricultural Research[2] has published 62 records on cows bred at recognized farms which averaged 3,934 pounds in 325 days and 77 records on purchased cows which averaged 3,854 pounds in 279 days.

Sahiwal

This is sometimes called the Montgomery breed. It is essentially a milk breed, native to the central and southern portions of the Punjab. Owing to their milking capacity, many animals are exported to other areas for milk production in the cities. The Imperial Council of Agricultural Research[2] has published 224 records from cows bred at recognized farms that averaged 5,085 pounds in 308 days and 37 records from purchased cows that averaged 3,471 pounds in 293 days. Several high producers have records of over 10,000 pounds. Detailed records of production are presented by the Imperial Council of Agricultural Research.[3] Reddish dun is the common color, and there are usually some white markings. The body is rather long, muscles are well developed and legs are short. Bullocks are useful for slow work. The head is broad, with short, stumpy horns. The dewlap and sheath are heavy and pendulous.

Group 4

Hallikar

These cattle are bred mainly in the Hassan, Mysore and Tumkur districts of Mysore State, and it appears to be the basic stock from which other so-called breeds of this group originated. The head and horns of these and other "Mysore cattle" are characteristic and different from any other type. The most striking features are the prominent forehead, usually furrowed in the middle, with a long face tapering towards the muzzle, and sharp horns which emerge near each other at the top of the poll and curve backwards and upwards

in a graceful sweep. The color is gray or dark gray and the males have a darker color over the neck, shoulders, hump and quarters. Light markings are frequently found on the face, dewlap, and under the body. The dewlap is moderately developed but the sheath is small. The cows are poor milkers.

Alambadi

These cattle are bred in the hilly areas of northern Salem and northern Coimbatore districts of Madras Province adjoining Mysore State. It is doubtful if this should be considered a separate breed, but rather as a part of the Hallikar breed of which it is an offshoot. In conformation and general appearance these cattle are very similar to the Hallikar.

Amrit Mahal

The former rulers of Mysore State bred these cattle for use in warfare and the government still maintains selected herds. They are not large animals but are fiery, active and famous for their powers of endurance. The general color is typical of most other breeds of this group, gray with dark head, neck, hump and quarters. This breed has well-defined light-gray or white markings on the face and dewlap. The prominent forehead and the sharp horns are similar to other breeds of this group. The dewlap is well developed but the sheath is small and tight. The cows are poor milkers. The Imperial Council of Agricultural Research[2] has published two records that averaged 2,103 pounds in 357 days.

Bargur

These cattle are bred extensively in the Bargur hills in the Coimbatore district of Madras Province. They are similar in conformation to other breeds of this group, but are smaller and more compact and the forehead is not so prominent. They are fiery, restive and difficult to train. The chief colors are red and white, red with white spots, white with red spots, and sometimes light gray. The cows are very poor milkers.

Kangayam

These cattle are bred mainly in the areas near Coimbatore and Erode in Madras Presidency, and the most important herd is maintained by the Pattigar of Palayakottai near Erode. They are very similar to other cattle of the Mysore type, but there is evidence of some infusion of blood of the gray-white cattle of the north of India. Calves are usually red at birth and gradually change to gray in three or four months. They are of moderate size, but are active and powerful, and are highly prized as draft animals. The dewlap is usually not large and the sheath is small and tight. The cows are generally poor milkers, but Pattabhiraman[9] reports that occasional individuals give 18 to 20 pounds daily at the peak of lactation.

Khillari (Killari)

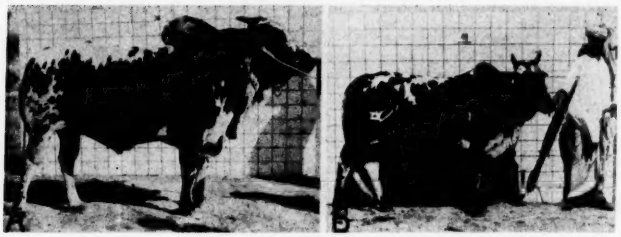
These cattle are found mainly in the Sholapur and Satara and other districts in southern Bombay Province. The breed is reported by Oliver[7] to be a derivative of Amrit Mahal, but is not so compact and active. There is some evidence of an infusion of blood from the gray-white cattle of the north. There is considerable variation in type.

Group 5

The cattle of this group are not divided into such well defined breeds as are those of the other groups, but some of the recognized types are described below.

Lohani

Animals of this breed are small, mature animals being 40 to 44 inches in height and are similar to the hill cattle of northern India. The characteristic color is red with white patches, although an entire red color is not uncommon. Cows are said to yield up to ten pounds of milk per day, but no records are available. The home of this breed is the Loralai Agency of Baluchistan and the northern districts of the Northwest Frontier Province. It is also widely distributed in adjacent tribal areas, where the animals are known as Acchai cattle.



DHANNI CATTLE

Figure 11

This breed is the only one included in Group 6. It is found in the northwest frontier provinces. The spotting resembles that of a Dalmatian dog. The bullocks are valued as draft animals.

Ponwar

These cattle are found in the northern and northwestern portions of the United Provinces. They are generally black and white in color. The face is small and narrow. Horns are long and upstanding. The dewlap and sheath are small. Bulls are said to weigh 700 to 800 pounds and cows about 650 pounds. These animals are active and often rather ferocious. The cows give little milk.

Siri

These animals are found in the hill tracts around Darjeeling and in Sikkim and Bhutan. Bhutan is said to be the real home of this breed. The colors most frequently seen are black and white and red and white. The coat is thick throughout the year. The forehead is wide and flat and the face is straight. Horns are sharp and are directed forward and slightly upward. The dewlap is only moderately developed and the sheath is small. Bullocks are good workers and cows are said to be fair milk producers.

Hill cattle

These are small, nondescript animals found in the foothills of the Himalayas and in the hills of Baluchistan. There is considerable variation in color and white markings are frequently seen on the forehead, dewlap and limbs. The most common colors are black, or some shade of red, varying from almost black to pale dun. The face is flat between the eyes, and the horns usually emerge outwards from the poll and curve upwards, inwards and forward. In the very stunted cattle seen at the higher levels in the Himalayas, the horns are often quite short.

Village cattle

The cattle commonly seen in the villages of India are nondescript, and there is much variation in type. This is especially true in Bengal and Assam and in other areas outside the sections where the improved breeds are produced. In some areas they show more or less evidence of blood from improved types in adjacent regions. In general, they are produced under conditions of scant feed and poor management, and when compared with the improved types in groups 1, 2, 3, 4 and 6, they are small and unproductive. However, the environment under which they are produced is in many cases inadequate to maintain the larger types.

Group 6

Dhanni

This breed is produced in the Attock, Rawalpindi and Jhelum areas of the Punjab and in the Northwest Frontier Province. They are medium-sized, compact, active animals and the bullocks are much prized as draft animals. The coloring in most animals consists of black or red spots on a white coat, varying from almost white animals with spots scattered evenly over the body (resembling those of a Dalmatian dog) to ani-

mals in which the greater portion of the skin is colored with the typical spotting visible only on certain parts. The face is flat. Small horns emerge laterally and curve outwards and upwards. The dewlap and sheath are small.

Conclusion

This paper presents a brief description of the breeds and so-called breeds of cattle of the species, *Bos indicus,* that are generally recognized in India. The breeds are divided roughly into six types. Much study is needed to determine if the grouping into six types is adequate and if the so-called breeds are all sufficiently distinct to be actually classified as breeds. The cattle of India are of great importance in their native country, and some breeds have already made important contributions in other tropical and sub-tropical countries. Some of these Indian breeds can make an even greater contribution in the future if wisely used in constructive breeding programs in tropical regions.

Owing to the wide diversity of types and breeds of cattle in India, the terms "Brahman" and "Zebu" are adequate only to indicate the species, *Bos indicus.* The general use of the breed names by which these cattle are known in their native country is recommended, in line with the established practice with European cattle and other types of livestock.

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✦

Motivation for Social Change

For those sociologists who work on the problems of the relation of group action to motivation, equally penetrating problems are posed. The Battle of Britain and the defense of Stalingrad have taught us—if we needed to have it taught us—that our traditional reliance upon personal pecuniary motivation leaves untapped vast potential sources of *social* motivation. And our own rather sorry morale in this war points an equally eloquent warning. Clearly, an organized society engaged in deciding and planning what shall happen to it will require the utmost of continuous social motivation at every step from the statement of needs and the formulation of the plan to the carrying of it out in action. (Needless to say, I am not envisaging a dream world in which personal and even pecuniary motivation will be absent, but, rather, a society in which all kinds of positive *social* motivation will also be encouraged and used to the utmost.) We know how rich are the motivational potentialities of human beings. How can the whole range of these motivations be evoked and used? Under what circumstances can people at the grass-roots be expected to broaden their habitual motivational orientation to include both local community and national aspects of the public interest? Our concern with polling surface attitudes and opinions regarding a miscellany of public issues is yielding acres of superficial data, but very little on the deeper motivational why's of people; and our how's for achieving social motivation from these studies go little beyond hints for the application of propaganda techniques. — Robert S. Lynd, *Amer. Soc. Rev.,* Feb., 1944.

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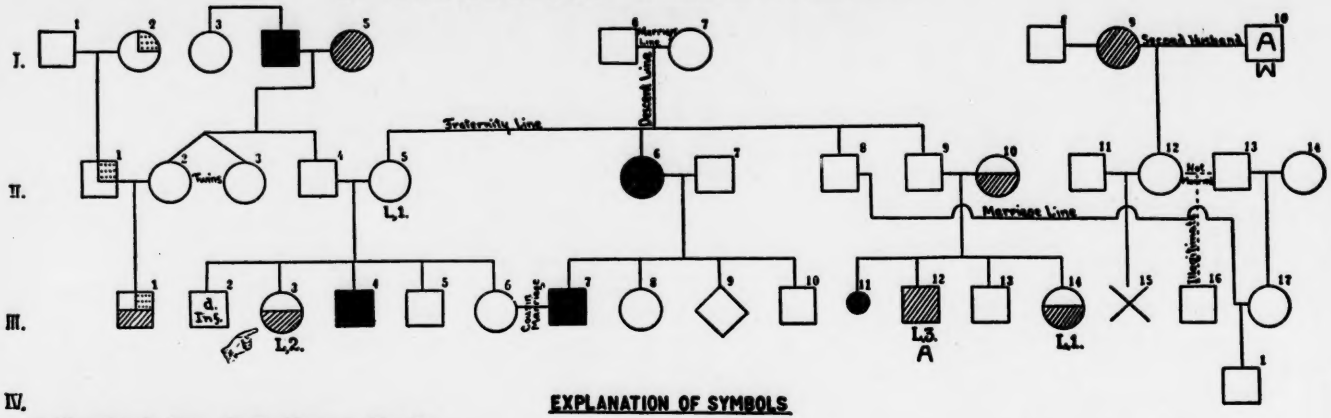

EXPLANATION OF SYMBOLS

(a) Standard for all Pedigree Charts:

□=Male; ○=Female; ◇=Sex unknown; ●=Still-birth or Miscarriage; X=Children — number and sex unknown; ○○=Twins; d. Inf.=Died in Infancy; ☞ Points to the Propositus or central figure in the pedigree.

□—○=Parents.

□○□○○=Children.

Roman figures to the left indicate generations; Arabic figures locate individuals, (thus III. 7 is the young man in the third generation who married his cousin).

The following letters, placed in or around the individual's pedigree symbol, are standard for certain traits: A, alcoholic; B, blind; D, deaf; E, epileptic; F, feebleminded; I, insane; M, migraineous; N, normal in reference to traits under consideration; Ne, neurotic; P, paralytic; Sx, sexually immoral; S, syphilitic; T, tuberculous; W, wanderer.

(b) Especially devised or selected for this particular pedigree-chart:

■ ● = Successful leaders in politics. ◱ ◷ = Extra thumb on right hand. L.1. = Highly successful author. L.3. = Little or no ability in literary efforts. ▨ ◍ = Superior in vocal music. ▨ ◍ = Medium attainment in vocal music.

To fit the particular family and traits (whether physical, mental or temperamental; good or bad) under consideration, invent special symbols, or select special letters (in addition to those standardized under (a) above) to be placed within or near the particular individual's pedigree symbol, to indicate particular traits and their degree of development.

Prepared by the International Commission of Eugenics. See *Journal of Heredity* for August 1926. Additional copies may be obtained from A.G.A.